Answers
Exam in Public Finance - Spring 2014
3-hour closed book exam
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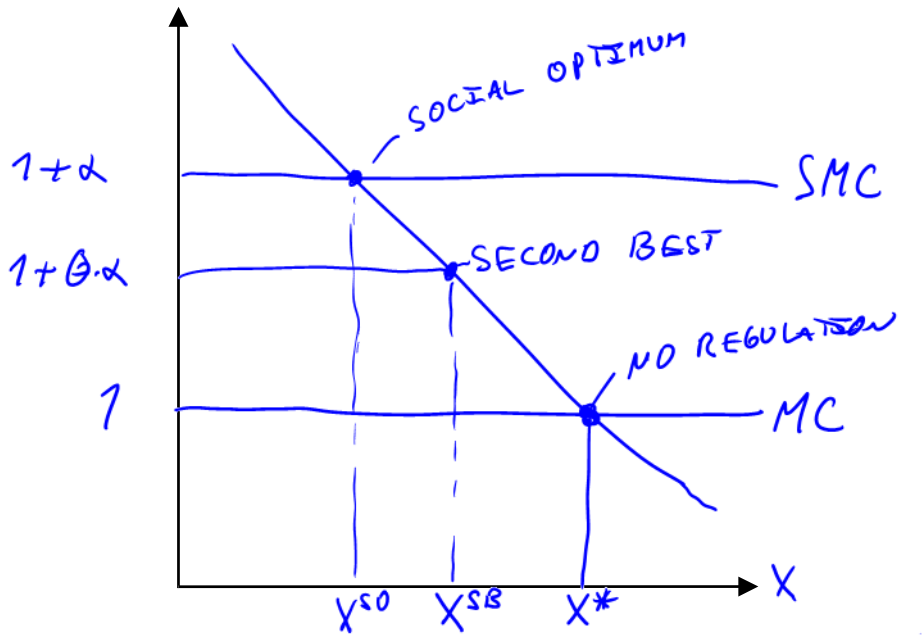
Part 1

(**1A**) No, they are not the same concepts. Tax pressure is defined as the sum of all taxes divided by aggregate income, while the excess burden of taxation/dead-weight loss of taxation measures the welfare gain if the existing taxation is replaced by lump sum taxes. Different examples may show that these concepts are not equivalent. For example, consider the case of lump sum taxation where each taxpayer pays a fixed amount in taxes. In this case, the excess burden of taxation is zero by definition, while tax pressure is positive. Another example is a tax system where the tax payment is zero for income below a certain threshold $\bar{y}$ while income above $\bar{y}$ is taxed at more than 100 percent. In this case, we may observe that no taxpayer earns an income level above $\bar{y}$ and therefore that tax pressure is equal to zero. If some taxpayers would earn more than $\bar{y}$ without the tax then the tax system is distortionary implying that the excess burden is positive.

(**1B**) A horizontal externality is an externality from one jurisdiction to another jurisdiction within the same hierarchical level of the public sector, while a vertical externality is working across different hierarchical levels. For example, a municipality that raises its tax may encourage some of the citizens to move to another municipality and thereby increase their tax base, which is an example of a horizontal externality because the municipality raising the tax does not take into account this positive effect on the other municipality (vice versa a reduction in the tax rate may attract tax payers from other municipalities and lead to tax competition among municipalities). The tax increase may also have a negative effect on the labor supply of those living in the municipality, which reduces tax revenue of the central government. This effect is not taken into account by the municipality and is therefore an example of a (negative) vertical externality. The vertical externality may imply that public consumption becomes too high at the local level and too low at the central level compared to the social optimum.

(**1C**) No, country-specific regulation will not internalize a global externality. An externality is present whenever some economic agent's welfare is directly affected by the action of another agent and for a global externality, for example related to greenhouse gas emissions, the action of an agent somewhere in the world will affect the well-being of people all over the world. If each country maximizes the aggregate welfare of its citizens then it will in its regulation policy

take into account the externality of one citizen on other citizens in the country but it will not take into account the effect on citizens in other countries. The is formalized theoretically in a teaching note used in the course. Below is an illustration of the results for the case without any global regulation policy and where a country imposes a tax on an externality-generating good x. The marginal cost of producing the good is 1, while the social marginal cost is $1+\alpha$, where α represents the size of the global externality. In a decentralized economy without any regulation the equilibrium consumption of the good equals x^*, while the social optimal consumption level, taking into consideration the global externality, equals x^{SO}. If the size of the country compared to the world economy is θ (e.g. measured by the size of the population relative to the total population) then it will be optimal for the country to impose a tax equal to $\theta\alpha$, which gives the second-best consumption level x^{SB}, which is higher than the level x^{SO} maximizing global social welfare.

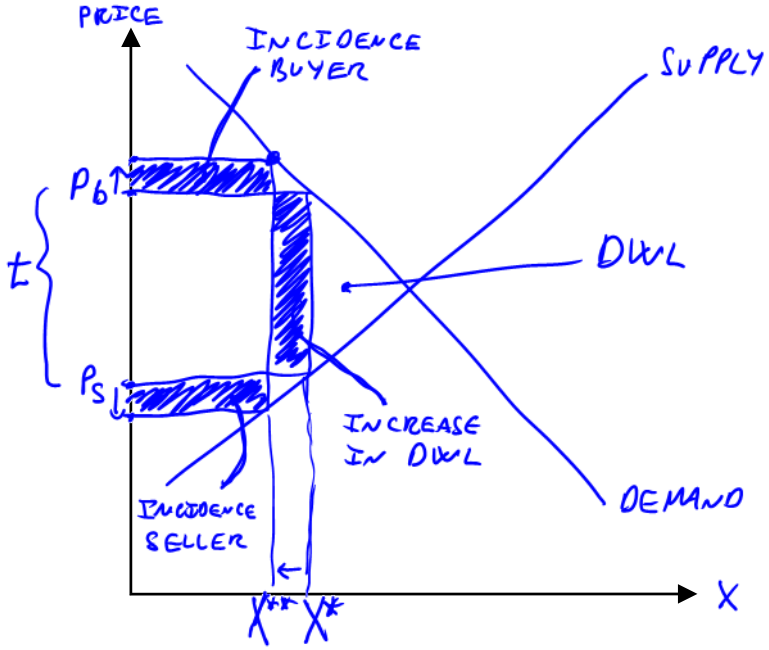


Second-best cases where regulation exists at the global level, but is insufficient to internalize the externality, may also be discussed. For example, there may be tradable licenses at the global level but with too many licenses issued compared to the first best. In this case, it is optimal for a country not to impose extra regulation such as a tax on the externality-generating good. The tax will reduce the demand for the externality-generating good but this will just reduce the price on licenses implying that global consumption of the externality-generating good is unchanged in equilibrium. Thus, initiatives of a single country to reduce consumption of the externality-generating good are ineffective in this case.

Part 2

(**2A**) The formal tax incidence describes who has the legal obligation to pay the tax, while the economic incidence describes the economic burden of the tax on the different agents. It is stated that the seller is paying the tax to the tax agency, which implies that the seller has the formal tax incidence in this case.

(**2B**) The marginal excess burden of a tax measures the increase in the excess burden/deadweight loss of the tax from a marginal increase in the tax rate, while the incidence of a tax increase measures how the extra tax burden is shared among buyers and sellers. The results/formulas show that the marginal excess burden is increasing in both the supply elasticity and the demand elasticity, as well as in the initial tax rate, while the tax incidence falls disproportionately on the side of the market that is least price elastic. Thus, it is the size of the elasticities that matters for efficiency, while it is the relative size of elasticities that matters for the incidence. The graph below illustrates the impact of a tax increase in a market.



The initial equilibrium with the tax t is x^* and p_s denotes the price after tax received by the seller, while p_b denotes the price paid by the buyer, and the area DWL denotes the deadweight loss of the tax. As illustrated in the diagram, the tax increase reduced the price after tax of the seller and raises the price of the buyer, implying that some of the burden of the tax increase is passed on to the buyer, although the seller has the formal tax incidence. The graph also illustrates the increase in the deadweight loss and how this is equal to the consequence on the government revenue of behavioral responses, i.e. the change in demand and supply because of the tax increase implies that equilibrium consumption/production falls from x^* to x^{**} and the loss of government revenue from the behavioral responses is approximately $t\,(x^* - x^{**})$. The

larger the elasticities, the larger is the change in consumption/production and therefore also the change in the deadweight loss.

(**2C**) The special case of a perfectly elastic supply corresponds to $\varepsilon_s \to \infty$ in the formulas presented in (2A) and a horizontal supply curve in the above graph. The special case of a perfectly inelastic demand corresponds to $\varepsilon_b = 0$ in the formulas presented in (2A) and a vertical demand curve in the above graph. In both cases, the incidence of the tax falls fully on the buyer. In the case with a perfectly elastic supply, a reduction in the price of the seller will simply make the seller reduce production until the price comes back to the original level, implying that the tax increase is passed fully to the buyer in the form of higher prices. In the case of a completely inelastic demand, the consumers will pay whatever price to obtain a given quantity, which implies that they have to pay all of the extra tax in order to have the seller produce the same quantity as before. In the case of a perfectly inelastic demand, the behavioral changes do not lead to any change in consumption/production in equilibrium, implying that the behavioral changes have no impact on government revenue and therefore no impact on the excess burden, which is zero in this case. On the other hand, with a normal demand curve a higher supply elasticity will all equal imply a larger excess burden (see the MEB formula), and the highest MEB is in the case with a perfectly elastic supply.

Part 3

(**3A**) By inserting the budget constraint in the utility function, utility may be written as

$$u = z - T(z) - \frac{\gamma a}{1+\gamma}\left(\frac{z}{a}\right)^{\frac{1+\gamma}{\gamma}}.$$

The first order condition with respect to z becomes

$$\begin{aligned} 1 - T'(z) - \left(\frac{z}{a}\right)^{\frac{1}{\gamma}} &= 0 \\ &\Updownarrow \\ z &= a(1-m)^{\gamma}. \end{aligned}$$

(**3B**) The elasticity of taxable income (ETI) is defined as $\text{ETI} = \frac{dz/z}{d(1-m)/(1-m)} = \frac{dz}{d(1-m)}\frac{1-m}{z}$, which is the percentage change in taxable income z with respect to a percentage change in the net-of-tax rate $1-m$. The elasticity measures the extent to which taxpayers change their taxable income when the net-of-tax rate is changed. It may be noted that the ETI captures all types of behavioral responses (hours of work, labor mobility, tax avoidance etc.) that reduce the (reported) income of the tax payer z and that it may be seen as a sufficient statistic to evaluate the efficiency effects of a tax change.

In order to compute the ETI, we first derive the impact on income from a marginal change in the net-of-tax rate from equation (1). This gives $dz/d(1-m) = a\gamma(1-m)^{\gamma-1}$. By inserting this in the definition of the ETI, we obtain

$$\begin{aligned} \text{ETI} &= a\gamma(1-m)^{\gamma-1}\frac{1-m}{z} \\ &= a\gamma(1-m)^{\gamma}\frac{1}{z} \\ &= \gamma, \end{aligned}$$

where the last equality follows from substituting equation (1) for z.

(**3C**) The assumption of the same γ parameter but different ability levels a implies that the choices of taxable income of type H and type L before and after the reform become

$$\begin{aligned} z_1^{\mathrm{H}} &= a^{\mathrm{H}}\left(1-m_1^{\mathrm{H}}\right)^{\gamma},\ z_2^{\mathrm{H}} = a^{\mathrm{H}}\left(1-m_2^{\mathrm{H}}\right)^{\gamma}, \\ z_1^{\mathrm{L}} &= a^{\mathrm{L}}\left(1-m_1^{\mathrm{L}}\right)^{\gamma},\ z_2^{\mathrm{L}} = a^{\mathrm{L}}\left(1-m_2^{\mathrm{L}}\right)^{\gamma}. \end{aligned}$$

A log transformation of these equations gives

$$\begin{aligned} \ln z_1^{\mathrm{H}} &= \ln a^{\mathrm{H}} + \gamma\ln\left(1-m_1^{\mathrm{H}}\right),\ \ln z_2^{\mathrm{H}} = \ln a^{\mathrm{H}} + \gamma\ln\left(1-m_2^{\mathrm{H}}\right), \\ \ln z_1^{\mathrm{L}} &= \ln a^{\mathrm{L}} + \gamma\ln\left(1-m_1^{\mathrm{L}}\right),\ \ln z_2^{\mathrm{L}} = \ln a^{\mathrm{L}} + \gamma\ln\left(1-m_2^{\mathrm{L}}\right). \end{aligned}$$

By inserting this into equation (2), we obtain

$$\frac{\gamma\left[\ln\left(1-m_2^{\mathrm{H}}\right)-\ln\left(1-m_1^{\mathrm{H}}\right)\right]-\gamma\left[\ln\left(1-m_2^{\mathrm{L}}\right)-\ln\left(1-m_1^{\mathrm{L}}\right)\right]}{\left[\ln\left(1-m_2^{\mathrm{H}}\right)-\ln\left(1-m_1^{\mathrm{H}}\right)\right]-\left[\ln\left(1-m_2^{\mathrm{L}}\right)-\ln\left(1-m_1^{\mathrm{L}}\right)\right]}=\gamma,$$

and since γ is the ETI according to (3B) this shows that it is correct that formula (2) may be used to compute the ETI.

(3D) Feldstein (1995) uses reform-generated variation in tax rates in the United States to estimate the ETI from formula (2). The variation in tax rates comes from a comprehensive tax reform enacted in the United States in 1986. The reform reduced tax rates on income financed by a broadening of tax bases. The high-income groups had by far the largest reductions in marginal tax rates and therefore also in the net-of-tax rate appearing in the denominator of formula (2). The table shows that the net-of-tax rate reduction was 42.2 percent for the group with the highest incomes and around 12.2 percent for taxpayers in the middle income range (column 1, rows 1 and 3). Columns 2 and 3 show the observed change in taxable income of the income groups from before the reform to after the reform. The difference between column 2 and 3 is the definition in income; here we will just focus on column 2 showing that income rose by 71.6 percent for the group with the highest income compared to 6.2 percent for the middle income group. Thus, if we compare these two groups, then taxpayers with the highest income raised income by 71.6-6.2=65.4 percent compared to the middle income groups (the numerator of formula (2)) and the relative change in the net-of-tax rate was 42.2-12.2=30.0 percent (the denominator of formula 2). These numbers are displayed in column 2, rows 4 and 6. We may now insert these differences across the two groups in income changes and in the net-of-tax rate in formula (2), and thereby compute the ETI. The result is an elasticity equal to 2.14, as shown in column 2, row 9. Feldstein makes this type of computation for different income groups and different income definitions, which gives the results displayed in rows 7-9. The conclusion is that the ETI lies in the range 1-3, which is very high elasticities, for example implying that the Laffer rate—the rate that maximizes government revenue—is very low and that marginal tax rates in for example Denmark would be higher than the revenue-maximizing tax rate.

(3E) The difference-in-difference estimation strategy applied by Feldstein controls for time invariant differences in the earnings potential of high-income and low-income groups by looking at the change over time for the two groups, respectively, and controls for time effects (income trend, business cycle variation) by comparing the changes in income over time for different income groups that are affected differently by the reform. A crucial assumption behind the identification strategy is that the different income groups would have experienced the same percentage change in income during the period in the (counterfactual) situation without a tax

reform. If the high income group has a higher underlying trend in income in the period then the estimation attributes this to the reform (other evidence for the United States does indicate that high income individuals have had a higher income trend during a long period starting before the studied reform). Another crucial assumption is that γ is identical for the two income groups. The reform affected the tax rates of all income groups implying that a control group not affected by the reform does not exist. Instead, the reform relies on the difference in treatment intensity (changes in the net-of-tax rate) across the different income groups combined with an assumption of identical underlying elasticity (γ) of the two groups. If, for example, γ is lower for individuals with lower income, implying that they respond less to the economic incentive, then it is possible to show that the identification strategy overestimate the ETI of both income groups.

Another potential problem that may be discussed concerns taxpayers located around the kink of the tax schedule where the marginal tax rate change. These taxpayers may be assigned to the top tax bracket or the middle tax bracket but this will in both cases create a downwards bias in the ETI estimates.

It may also be mentioned that intertemporal income shifting because of the reform (income is paid out in a different year than the income is earned in order to save taxes) may imply an upwards bias in ETI estimates using the years just before and after the reform.